PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Mixing or Drying Apparatus

I, AQUILA FORSTER, a British Subject, of "Highlands," Glentrammon Road, Green Street Green, Farnborough, Kent, England, do hereby declare the invention, for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to mixing and/or drying apparatus and it is an object of the invention to provide improved apparatus for intimately intermixing solid particles with other solid particles or with liquids or pastes or semi-liquids or for drying solids or mixtures, e.g. moulding powders, pigments, food-stuffs, medicaments or explosives.

The invention provides apparatus for intimately intermixing or drying solid particles with or without other solid particles and/or liquids and/or the like (such particles and/or liquids and/or the like being hereinafter referred to as the material), comprising in combination, a trough, at least one member (hereinafter referred to as a smearing member) movable over an interior surface of the trough, means for moving the smearing member (or members) thereover to submit the material to a smearing, kneading, rubbing or like action between the smearing member (or members) and the said interior surface, at least one scoop or the like, and means for moving the scoop over the said interior surface to lift material which has been subjected to the said action and to transfer the material along the length of the trough.

Preferably the said interior surface of the trough is of part-cylindrical form, the (or each) smearing member has a part-cylindrical surface for co-operation therewith, and the (or each) smearing member is arranged for rotation about the common axis of curvature of the said surfaces. Preferably the scoop is carried by (preferably integral with) the trailing edge of the smearing member. Preferably the (or each) smearing member is carried on a shaft extending along the common axis either by rigid connecting arms or is resiliently mounted on such a shaft (e.g. by springs) to provide an adjustable pressure between the smearing surface or surfaces and the interior surface of the trough. Preferably there are a plurality of smearing members, each provided with a scoop, arranged to act in turn on the material as it is transferred along the length of the trough. Preferably the base of each scoop is inclined to the horizontal so as to pour the material towards the next smearing member and so along the length of the trough, thus providing a flow of material from the input to the outlet. The rate of flow of material is adjusted by the rate of input, by the shape of the scoop and by the rate of rotation of the scoop. The material arriving at the outlet end of the trough may be discharged through an opening in the floor or side or end wall of the trough. Restricting means, e.g. a gauze, may be provided at or adjacent to the outlet opening, to hold back coarser particles to be discharged beyond the opening. Alternatively, the end of the trough may be open and the material may be discharged through this open end or through a gauze or over a weir across the open end.

The trough may be provided with a cover.

Means may be provided for heating or cooling material in the trough. For example, a steam or hot water heated jacket may be provided for assisting the drying of material in the trough.

The jacket may rigidly be secured to the trough or may be removable. It is preferred that such a jacket is provided with means to assist in the removal of fumes and moisture. The jacket may completely enclose the trough, or may be adapted to surround only a selected part of the trough and it may be constructed of a number of components which may be used separately in or combination. Unjacketed parts of the trough may be provided with covering means.

A specific construction of apparatus embodying the invention will now be described by way of example; and with reference to the drawing

[*Price 3s. 6d.*]

accompanying the Provisional Specification, which drawing is a perspective view of the apparatus, partly cut away.

In this construction, the apparatus, which is for use for intimately intermixing ingredients, e.g. gypsum and talc, comprises an open top semi-cylindrical horizontal rigid metal trough 10 supported on legs 12. The ends of the trough are closed by walls 14 and 15, except for an outlet 16 at the bottom of the wall 15. The trough, in this example, is about 12 feet long and 2 feet in diameter. A shaft 20 is journalled in the end walls 14, 15, and extends along the axis of the semi-cylinder. The shaft has radially extending arms 22 incorporating compression springs which carry a series of semi-cylindrical smearing plates 24, 24A having external diameters equal to, or very slightly less than, the internal diameter of the trough 10. The series of smearing plates extends along the whole length of the trough, each plate, in this example, being about 1 ft. 6 ins. long. Only two plates of the series are shown in the drawing.

A baffle 26 upstands from the sides and ends of the trough to prevent spilling out of the material.

The shaft 20 is driven continuously in one direction at about 30 to 60 r.p.m. by a motor coupled to it either directly, or by a driving belt. The trailing edge of each smearing plate is bent to provide a collecting scoop 25 in the form of a channel extending along the length of the trailing edge. The bottom of the channel is skewed with respect to the shaft 20 so that when the scoop is in such a position that the bottom of the channel is lowermost that end of the bottom of the channel which is nearer to the trough outlet 16 is lower than the other end. The materials to be mixed are fed into the trough at the end remote from the outlet. As the smearing plates 24 rotate, they submit the material which lies between them and the curved interior surface of the trough to a combination of pressure and rubbing in which aggregates of particles are broken down into individual particles and the particles of the different ingredients are smeared or bonded together in more intimate combination than in a loose particle mixture. After a plate has acted on some of the material, the scoop sweeps across it and picks up that material and lifts it above the trough. The inclined form of the scoop causes some or all of the material in it to run down the length of the scoop towards the outlet, and fall from the scoop, into the inside of the next smearing plate in the series. As the scoop rotates the remainder of the material in the scoop then falls partly back into the bottom of the trough and partly forwards between the same plate and the baffle 26 to be subsequently acted on again. Such an action effects a high degree of mixing. The material poured into the inside of the next smearing plate is tipped out on to the interior surface of the trough when that plate turns over above the trough and is then acted upon by that plate. The proportion of material which is passed forward can be arranged as required by the inclination of the bottoms of the scoops and by the speed of their rotation. The volume of material passed forward is limited by the capacity of the scoop which is prearranged as desired. Adjacent plates overlap to prevent material accumulating in the trough between the plates. The successive plates are disposed at about 180° around the shaft, so that as the scoop of a plate rises above the edge of the trough, the leading edge of the next plate is just rising above that edge. The trailing edge of the scoop lies in close contact with the inside of the trough in order to scrape the interior surface of the trough clean of material into the scoop.

A modification of this construction may be used for the continuous drying of solids or mixtures, e.g. for drying ammonium nitrate. For this purpose, the trough is provided with a steam jacket or with other means for drying the material. The jacket may be fixed rigidly to the trough or be removable and it may be constructed of a number of components which may be used separately or in combination so that only selected portions of the trough are subjected to its action if desired. The trough is also provided with a cover, the interior of which communicates with an air exhaust trunk. Moisture and fumes are removed and the drying of material in the trough facilitated. The passage of material through the trough is effected substantially as in the first construction described. The smearing action of the plates, with or without pressure, brings the material into close contact with the heated surface of the trough and so accelerates the transfer of heat into the material. The pouring of the material from the scoops assists the evaporation and release of the moisture, and so assists the drying process.

This modified apparatus may also be used for continuous cooling of hot materials with similar benefit from the smearing and pouring actions, a cooling fluid (e.g. cold water) being in that case passed through the jacket.

The apparatus may be used for both mixing and drying at the same time. The materials to be mixed may be added at the position in the apparatus which corresponds to any desired stage of the process. It may be preferred to add all the ingredients to be mixed at the input end and so subject them all to the heating needed for drying one or more of the ingredients. Again, it may be preferred to add one or more of the materials to be mixed at a later stage in the process, (i.e. further down the apparatus, after one or more have already been subjected to drying in the upper end of the apparatus) and it may be preferred to reduce the temperature at which one or more of the ingredients are added at a later stage by reducing the temperature in a section of the jacket at that

point; again, it may be preferable to add one or more of the ingredients at ordinary temperatures after one or more ingredients have been dried in one section of the trough and cooled down to ordinary temperature in another section of the trough provided with a cooling jacket. Again, it may be required to melt (or, alternatively, to avoid melting) one or more ingredients during mixing and these objects can be achieved by suiable arranging the points and the temperature along the trough at which the ingredients are added. Alternatively, these actions may be carried out in two or more troughs in series maintained at suitable temperatures by means of heating and cooling jackets. The apparatus of the foregoing examples have special efficiency for the continuous most intimate mixing or compounding, or for the drying of materials. The apparatus is of simple construction and actuation, with comparatively slow moving parts and mild action, and is adaptable to provide a wide range of methods of mixing and of drying and of operation combined with continuity, and further is suitable for materials sensitive to overheating or impact.

A feature of this apparatus is that while it provides continuous mixing and/or drying the flow through of material is effected strictly in steps with little or no bypassing of any of those steps.

The invention is not restricted to the details of the foregoing examples. The plates may overlap in a longitudinal, as opposed to a lateral, sense. For instance, the arcuate length of plate 24A may be reduced and the plate displaced to the left so that it overlaps with the right end of plate 24.

The size of the scoops may be varied (e.g. made larger than those indicated in the drawing) according to the desired rate of throu3h-put.

Means may be provided for imposing a clearance between the smearing plates and the interior surface of the trough should the characteristics or requirements of the product make such a clearance necessary or desirable.

The trough and other components of the apparatus may be constructed from sheet aluminium or any other suitable material.

WHAT I CLAIM IS:—

1. Apparatus for intimately intermixing or drying solid particles with or without other solid particles and/or liquids and/or the like (such particles and/or liquids and/or the like being hereinafter referred to as the material) comprising in combination a trough, at least one smearing member movable over an interior surface of the trough, means for moving the smearing member thereover to submit the material to a smearing, kneading, rubbing or like action between the smearing member and the interior surface, at least one scoop or the like, and means for moving the scoop over the interior surface to lift material which has been subject to the said action and to transfer the material along the length of the trough, in which apparatus the interior surface of the trough is of part-cylindrical form and the smearing member has a part-cylindrical surface for co-operation therewith, and the smearing member and the scoop are arranged for rotation about the common axis of curvature of the said surfaces.

2. Apparatus, as claimed in Claim 1 in which the scoop is carried by the trailing edge of the smearing member.

3. Apparatus, as claimed in Claim 1 or Claim 2 in which the scoop is formed integrally with the trailing edge of the smearing member.

4. Apparatus, as claimed in any one of the preceding Claims, in which the (or each) smearing member is carried on a shaft extending along the common axis by rigid connecting arms.

5. Apparatus, as claimed in any one of Claims 1—3, in which the (or each) smearing member is resiliently mounted on a shaft extending along the common axis.

6. Apparatus, as claimed in any one of the preceding Claims, in which there are a plurality of smearing members, each provided with a scoop, arranged to act in turn on the material as it is transferred along the length of the trough.

7. Apparatus as claimed in Claim 6 in which the base of each scoop is inclined to the said axis so as to pour the material towards the next smearing member along the length of the trough.

8. Apparatus, as claimed in any one of the preceding Claims, in which the trough is provided with an outlet opening adjacent one end.

9. Apparatus, as claimed in Claim 8, in which restricting means (e.g. a gauze or a weir) are incorporated at or adjacent to the outlet opening.

10. Apparatus, as claimed in any of the preceding Claims, in which means are provided for heating or cooling material in the trough.

11. Apparatus for intimately intermixing or drying solid particles with or without other solid particles and/or liquids and/or the like substantially as hereinbefore described with reference to, and illustrated in, the drawing accompanying the Provisional Specification.

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111 & 112, Hatton Garden, London, E.C.1,
Chartered Patent Agents.

PROVISIONAL SPECIFICATION

Improvements in or relating to Mixing or Drying Apparatus

I, AQUILA FORSTER, a British Subject, of "Highlands," Glentrammon Road, Green Street Green, Farnborough, Kent, do hereby declare this invention to be described in the following statement:—

The invention relates to mixing and/or drying apparatus and it is an object of the invention to provide improved apparatus for intimately intermixing solid particles with other solid particles or with liquids or pastes or semi-liquids or for drying solids or mixtures, e.g. products, intermediates, moulding powders, pigments, food-stuffs, medicaments or explosives.

The invention provides apparatus for intimately intermixing or drying solid particles with or without other solid particles and/or liquids and/or the like (such particles and/or liquids and/or the like being hereinafter referred to as the material), comprising in combination a trough, at least one member (hereinafter referred to as a smearing member) movable over the interior surface of the trough, means for moving this smearing member (or members) thereover to submit the materials to a smearing, kneading, rubbing or the like action between the smearing member or members and the said interior surface, at least one scoop or the like, and means for moving it over the said interior surface to lift material which has been subjected to the said action and to transfer it along the length of the trough.

Means may be provided for drying the contents of the trough, e.g. a steam or hot water heated jacket.

Preferably the inner surface of the trough is of part cylindrical form the (or each) smearing member has a part-cylindrical face for co-operation therewith, and the (or each) smearing member is arranged for rotation about the common axis of the said surfaces. Preferably the scoop is carried by (preferably integral with) the trailing edge of the smearing member. Preferably there are a plurality of smearing members arranged to act in turn on the material as it is transferred along the length of the trough. Preferably the smearing member or members are carried on a shaft along the common axis either by rigid connecting arms or by springs to provide an adjustable pressure between the smeating surface or surfaces and the inner surface of the trough. Preferably the base of each scoop is inclined to the horizontal so as to pour the material towards the next smearing member and so along the length of the trough, thus providing a flow of material from the input to the outlet. The rate of flow of material is adjusted by the rate of input, by the shape of the scoop and by the rate of rotation of the scoop. The material arriving at the outlet end of the trough may be discharged through an opening in the floor or side or end wall of the trough. This opening may be provided with a gauze to hold back coarser particles to be discharged beyond the opening. Alternatively, the end of the trough may be open and the material may be discharged through this open end or through a gauze or over a weir across this open end.

Two specific constructions of apparatus embodying the invention will now be described by way of example.

In one of these constructions the apparatus is for use for intimately intermixing ingredients, e.g. gypsum and talc. The apparatus comprises an open top semi-cylindrical horizontal rigid metal trough supported on legs. The ends of the trough are closed, except for an outlet at the bottom of one end wall. The trough is in this example about 12-feet long and 2-feet diameter. A shaft is journalled in end walls and extends along the axis of the semi-cylinder. This shaft has radially extending arms incorporating compression springs which carry a series of smearing plates which are each of semi-cylindrical shape, about 1-ft. 6-ins. long and having an external diameter equal to, or very slightly less than that of the interior surface of the trough. The series of smearing plates extends along the whole length of the trough.

The shaft is driven continuously in one direction by a motor coupled to it directly or by a driving belt of about 30 to 60 r.p.m. The trailing edge of each smearing plate is bent to provide a collecting scoop in the form of a channel extending along the length of the trailing edge. The bottom of the channel is inclined to the horizontal dipping towards the trough outlet. The materials to be mixed are fed into the trough at the end remote from the outlet. As the smearing plates rotate they submit the material which lies between them and the inner wall of the trough to a combination of pressure and rubbing in which aggregates of particles are broken down into individual particles and the particles of the different ingredients are smeared or bonded together in more intimate combination than in a loose particle mixture. After a plate has acted on some of the material the scoop sweeps across it and picks up that material and lifts it above the trough. The inclined form of the scoop causes some or all of the material in it to run down the length of the scoop to fall from the scoop towards the outlet, into the inside of the next smearing plate in the series. The remainder is then poured back between the same plate and the trough to be acted on again. Such a pouring action effects a high degree of mixing. The material poured into the inside of the next smearing plate is then tipped out on to the inner surface of the trough when that plate turns over above the trough and is then acted upon by that plate. The proportion which is

passed forward can be arranged as required by the inclination of the bottom of the scoop and by the speed of the rotation. The successive plates overlap to prevent material accumulating in the trough between the plates. The successive plates are disposed at about 180° around the shaft, so that as the scoop of a plate rises above the edge of the trough the leading edge of the next plate is just rising above that edge. The trailing edge of the scoop preferably lies in close contact with the inside of the trough so as to scrape the trough surface clean of material into the scoop; alternatively a clearance may be allowed according to the characteristics or requirements of the product.

A baffle upstands from the sides and ends of the trough to prevent spilling out of the material.

The construction just described is shown on the accompanying drawing.

In the other of the aforesaid constructions, which is a modification of the construction just described, the apparatus is for use in continuous drying of solids or mixtures, e.g. for drying ammonium nitrate. For this purpose the trough is provided with a steam jacket or with other means for drying the material and the trough may be provided with a cover and the interior of the cover may communicate with an air exhaust trunk to remove moisture and so facilitate drying of the material in the trough. The passage of the material through the trough is effected substantially as in the first construction described. The smearing action of the plates with or without pressure brings the material into close contact with the heating surface of the trough and so accelerates the transfer of heat into the material. The pouring of the material from the scoops assists the evaporation and release of the moisture, and so assists the drying of the material.

The apparatus may be used for continuous cooling of hot materials with the same benefits from the smearing and pouring actions. For this purpose cold water or cooling liquid may be passed through the jacket.

The apparatus may be used for both mixing and drying at the same time and it is a feature of the apparatus that the materials to be mixed may be added at any desired stage in the apparatus according to requirements. It may be preferred to add all the ingredients to be mixed at the input end and so subject them all to the heating needed for drying one or more of the ingredients. Again, it may be preferred to add one or more of the materials to be mixed at a later stage further down the apparatus, after one or more have already been subjected to drying in the upper end of the apparatus, and it may be preferred to reduce the temperature at which one or more of the ingredients are added at a later stage by reducing the temperature in a section of the jacket at that point; again it may be preferable to add one or more of the ingredients at ordinary temperatures after one or more ingredients have been dried in one section of the trough and cooled down to ordinary temperature in another section of the trough provided with a cooling jacket. Again it may be required to melt (or alternatively to avoid melting) one or more ingredients during mixing and these objects can be achieved by suitably arranging the points and the temperature along the trough at which the ingredients are added. Alternatively these actions may be carried out in two or more troughs in series maintained at suitable temperatures by means of heating and cooling jackets. The apparatus of the foregoing examples have special efficiency for the continuous most intimate mixing or compounding, or for the drying of materials.

The apparatus is of simple construction and actuation, with comparatively slow moving parts and mild action, and is adaptable to provide a wide range of methods of mixing and of drying and of operation combined with continuity, and, further is suitable for materials sensitive to overheating or shock.

A feature of this apparatus is that while it provides continuous mixing and/or drying the flow through of material is effected strictly in steps with little or no bypassing of any of those steps.

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846,899 PROVISIONAL SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.